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Standard Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Based Products[1]

This standard is issued under the fixed designation D3201/D3201M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method prescribes the procedure for determining the hygroscopicity of fire retardant treated wood products by determining the moisture content of fire-retardant-treated wood and wood-based product specimens after exposure to a test condition of 92 ± 2 % relative humidity at 81 ± 4°F [27 ± 2°C].

1.2 The text of this test method references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this test method.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, ~~to ensure conformance with the standard,~~ each system shall be used independently of the ~~other, and~~other. Combining values from the two systems ~~shall not be combined.~~has the potential to result in non-conformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D9 Terminology Relating to Wood and Wood-Based Products
E84 Test Method for Surface Burning Characteristics of Building Materials
E176 Terminology of Fire Standards
E2768 Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test)

3. Terminology

3.1 *Definitions*—Definitions used in this practice are in accordance with Terminologies D9 and E176.

[1] This test method is under the jurisdiction of ASTM Committee D07 on Wood and is the direct responsibility of Subcommittee D07.07 on Fire Performance of Wood.
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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4. Significance and Use

4.1 The hygroscopic properties of wood and wood-based products treated with fire-retardant chemicals are often greater than for untreated products. This is particularly true at the higher relative humidity conditions. This higher hygroscopicity sometimes is the cause for staining, decay, poor paint adhesion, and migration and exuding of chemicals and moisture at the high humidities. Corrosion of metal fasteners sometimes also occurs.

4.2 The results obtained with this standard are important in identifying treatments with low hygroscopic properties.

4.3 Results can be useful in determining exposure limitations in service for specific treated products.

4.4 Building codes and other specifications for fire-retardant-treated wood for interior use include requirements based on this test method.

5. Apparatus

5.1 *Conditioning* chamber with air circulation and capable of being maintained at 81 ± 4°F [27 ± 2°C] and a relative humidity of 92 ± 2 %.

5.2 *Oven,* air-circulated and vented, capable of maintaining a temperature of 217 ± 4°F [103 ± 2°C].

5.3 *Weighing Scale*—A scale or balance that will weigh a specimen within an accuracy of ±0.2 %.

6. Test Specimens

6.1 A minimum of five specimens shall be selected from the untreated product/species combination that is to be tested. Solid wood specimens with identifiable sapwood shall be selected with as much sapwood as can be readily obtained from the lot of material from which it is selected.

6.2 *Specimen Size:*

6.2.1 Solid wood specimens shall be cross sections cut from solid sawn, surfaced lumber of nominal 2×6 size. The test specimens shall be 1.0 ± 0.1 in. [25 ± 3 mm] along the grain by 5.5 ± 0.1 in. [139 ± 3 mm] wide by 1.5 ± 0.1 in. [38 ± 3 mm] deep.

6.2.2 Panel product specimens shall be cut from panels with a nominal thickness between 15/32 in. [12 mm] and 5/8 in. [16 mm]. The test specimens shall be the thickness of the panel by 5.5 ± 0.1 in. [139 ± 3 mm] by 5.5 ± 0.1 in. [139 ± 3 mm].

6.2.3 Products for which the specimen sizes in 6.2.1 and 6.2.2 are not applicable may be tested using specimens with surface area to volume ratios greater than 3.7 $in.^2$:1 $in.^3$ [0.15 mm^2:1 mm^3] and minimum mass of 0.11 lb. [50 g].

6.3 Treatment with fire-retardant chemicals shall be done in a manner representative of that for the product/species being tested.

6.3.1 The fire retardant chemical retention of the treated product shall not be less than that specified by the agency certifying the flame spread index of the treated product. The retention shall provide a flame-spread index of 25 or less when tested in accordance with either Test Method E2768 or with Test Method E84 for 10 min with no evidence of significant progression combustion when the test is continued for an additional 20-min period and without progression of the flame front beyond a distance of 10.5 ft. [3.2 m] beyond the centerline of the burners anytime during the 30-min extended test.

6.3.2 The provisions of 6.3.1 are not intended to prevent use of this test method when the fire-retardant treatments being tested are for applications other than those requiring conformance to building code requirements for "fire-retardant-treated wood" that require Test Method E84 test extended to 30 min or Test Method E2768. When alternative performance criteria for the treated products are applicable, the test report shall include the alternative performance criteria and the treatment retention required for specimens conforming to any alternative performance criteria.

NOTE 1—The use of solid wood, untreated control specimens is recommended to provide verification of the high-humidity testing conditions.

NOTE 2—Southern pine sapwood is suggested as the test species because it requires higher fire-retardant chemical retentions to obtain the same flame spread rating compared to other commonly used species. Because the hygroscopicity of fire retardant treated wood correlates to the chemical retention levels, southern pine is believed to represent a worst case scenario for the same chemical formulation and treating procedures. Thus, testing of other species, rather than by application of southern pine test results, are considered to be indicative of that species only.

7. Procedure

7.1 All measurements of the specimen weight shall be to an accuracy of ±0.2 %.

7.2 The specimens shall be air dried in a laboratory at normal indoor ambient temperature and 30 to 65 % relative humidity for at least 14 days prior to high-humidity exposure. Specimens shall be separated while drying to permit unrestricted air flow to all surfaces.

7.3 If the specimens will support fungal or mold growth during the high humidity exposure, they shall be sprayed with a suitable biocide just prior to air drying (see 7.2).

7.4 Weigh each specimen to obtain weight prior to high humidity exposure.

7.5 Expose all specimens under constant humidity conditions of 92 ± 2 % at 81 ± 4°F [27 ± 2°C] for not less than 168 or more than 180 hours. Specimens shall be suitably suspended so that all surfaces are exposed.

NOTE 3—In this test method, the specimens are not exposed for sufficient duration to obtain equilibrium moisture content. This test method was developed for fire-retardant-treated wood. For the purpose of identifying treatments with low hygroscopic properties, the duration of 168 hours (seven days) has been shown to be adequate. If the method is applied to other materials, the necessity for a longer duration of exposure needs to be investigated.

7.6 If the specimens exude moisture or chemicals or both under the exposure conditions, collect any drippings and include the weight with the specimen weight.

7.7 Weigh each specimen immediately, after its removal from the conditioning chamber to obtain the weight after high humidity exposure. Observe and record the general appearance of the specimens.

7.8 Dry each specimen in an oven at 217 ± 4°F [103 ± 2°C] until constant weight is attained, and reweigh to obtain oven-dry weight after high humidity exposure. Constant weight is assumed when two consecutive readings taken 2 h apart are within 0.2 %. Avoid drying for periods longer than necessary to achieve constant weight, since thermal decomposition of chemical or wood might occur reflecting a higher than actual moisture content.

8. Calculations

8.1 Calculate the moisture content of each specimen prior to high-humidity exposure (u_i) as follows:

$$u_i, \% = \frac{m_i - m_{od}}{m(od)} \times 100 \quad (1)$$

where:

m_i = weight of specimen prior to high-humidity exposure, and
m_{od} = oven-dry weight of specimen after high-humidity exposure.

8.2 Calculate the moisture content of each specimen after high-humidity exposure (u_f) as follows:

$$u_f, \% = \frac{m_f - m_{od}}{m(od)} \times 100 \quad (2)$$

where:

m_f = weight of the specimen after high-humidity exposure, and
m_{od} = oven-dry weight of specimen after high-humidity exposure.